

The culture of Bornean phasmids.

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Introduction

At the PSG meeting at the Natural History Museum, London, on 22nd 1995, I gave an illustrated lecture on the species of Bornean phasmids which have been reared in captivity. The talk stressed that the "culture potential" i.e. the likelihood of establishing a culture, of a given species appears to depend upon the flight capability of the species. There is a close correlation between culture potential and taxonomic position; this is not unexpected as flight capability is generally closely linked to the taxonomic position of phasmids. This article summarises the lecture.

Since December 1987 I have visited Borneo on 7 occasions, spending a total of about six months on the island. Borneo is the third largest island in the world and is composed of four political units: Brunei (an independent country), Kalimantan (part of Indonesia), Sarawak (a State of Malaysia) and Sabah (also part of Malaysia). Most of my collecting has been done in Sarawak, although I spent five weeks in Kalimantan, three in Brunei, and two in Sabah.

My first visit to Borneo was a two week holiday with my wife and Lee Yong Tsui in December 1987 and January 1988, during this time we stayed with Dr Lee's family in Sarawak. Although not a collecting trip, seven species were collected over two nights and five of these were bred in the UK. All subsequent trips have been made specifically to collect phasmids and, whenever possible, to attempt to rear them in the UK. On each of these trips, with the exception 1993, I was accompanied by another member of the Phasmid Study Group, these were: Patrick van der Stigchel (1989), Paul Jennings (1990), Ian Abercrombie (1991 & 1994) and Paul Inglis (1992). During collecting trips to Sabah (one week in 1990 and one week in 1992), we were accompanied for some of the time by PSG member C.L. Chan who lives in Kota Kinabalu, Sabah. While in Brunei for a week in 1994 we stayed at the home of PSG member Mel Herbert who collected with us. I have spent 88 nights collecting phasmids in Borneo, with a mean of about five hours searching per night.

Prior to 1988 most of the species which have been cultured from Borneo were originally cultured from stock collected by Allan Harman or Jonathan Cocking in the early 1980s; most of these have since been supplemented by my own collections. A few of the early attempts, although listed on the PSG species list, were never established in culture and in two cases (PSG 65 and PSG 68) the identity of the species are unknown.

There are about 300 species of phasmid recorded from Borneo; there are also many undescribed species and some species which have been described from elsewhere but not yet recorded from Borneo. I have collected females of about 140 species and feel that I have sufficient data to make reliable predictions about the likelihood of establishing any given species in culture. Essentially the chance of establishing a culture depends on the flight capability of the females, if the females can fly there is little likelihood of establishing a culture. The reason for this appears to be related to their degree of polyphagy.

The data below summarises the Bornean species which have been successfully maintained in captivity in the UK. To qualify as being "successfully maintained", the species must have been kept alive for at least one month after arrival in the UK, or, in the case of eggs, nymphs must progress to at least second instar; in both cases the insects must feed on plants grown in the UK. In most cases successful maintenance has resulted in sustainable cultures. Although I have

personally maintained most of the following species in captivity there are a few which were originally only maintained by my companions, notably *Nearchus redtenbacheri* by Paul Jennings, and *Dinophasma saginata* and *Hoploclonia abercrombiei* by Ian Abercrombie.

For convenience the data is grouped by subfamily. In some cases the number of species recorded from Borneo is not clear because of the uncertain status of some nominal species. I have included a few species which are known to occur in Borneo but have only been cultured from sources outside Borneo.

Heteropteryginae

Although the members of the tribe Heteropterygini have wings, none can fly, with the possible exception of the males of *Heteropteryx dilatata*. All members of the other two Bornean tribes, Obrimini and Datamini, are wingless. The subfamily contains 24 or 25 Bornean species (25 if *Aretaon asperrimus* and *A. muscosus* are distinct species). All 16 species which have been collected have been reared in captivity; 15 have given rise to sustainable cultures. The descriptions of two of the species listed in this subfamily have not yet been published. The following have been successfully maintained in captivity:

Heteropterygini: *Haaniella dehaani* (Westwood), *H. echinata* (Redtenbacher), *H. grayi* (Westwood), *H. saussurei* Kirby, *H. scabra* (Redtenbacher), *Heteropteryx dilatata* (Parkinson).

Obrimini: *Aretaon asperrimus* (Redtenbacher), *Hoploclonia abercrombiei* Bragg, *H. cuspidata* Redtenbacher, *H. gecko* (Westwood).

Datamini: *Dares ulula* (Westwood), *D. validispinus* Stål, *D. verrucosus* Redtenbacher, *Datames borneensis* Bragg [in press], *Epidares nolimetangere* (de Haan), *Spinodares jenningsi* Bragg [in press].

Phasmatinae

There are about 13 species recorded from Borneo, all are in the tribes Baculini and Pharnaciini. The females of both these tribes are wingless. I have collected only four species, two have been successfully reared. In addition *Pharnacia serratipes*, has been reared from West Malaysian stock. The species which have been successfully maintained in captivity are all in the Pharnaciini: *Nearchus redtenbacheri* Dohrn, *Pharnacia kirbyi* (Brunner), *P. serratipes* (Gray).

Phyllinae

Four species are recorded from Borneo, three have been reared although none of the reared stock originated in Borneo: *Phyllium bioculatum* Gray, *P. giganteum* Hausleithner, *P. pulchrifolium* Audinet-Serville.

Aschiphasmatinae

This subfamily contains 27 species from Borneo. I have collected about 19 species although in some cases only males were found. The only ones to be reared are all in the same genus, *Dinophasma*, this is the only genus in the subfamily in which the females are always wingless. These three species all feed on *Fuchsia* and numerous early attempts to rear them on other foodplants were unsuccessful. However Paul Jennings has recently raised second generation stock of *D. guttigera* on bramble.

The three species which have been successfully maintained are: *Dinophasma guttigera* (Westwood),

D. kinabaluensis Bragg [in prep], *D. saginata* (Redtenbacher).

Lonchodinae

All members of this subfamily are wingless. The only Bornean species which I have collected but have not maintained in captivity are two species which died before reaching the UK.

The following species have been successfully maintained in captivity: *Carausius sanguineoligatus* (Brunner), *C. chani* (Hausleithner), *C. cristatus* Brunner, *C. abbreviatus* (Brunner), *C. mirabilis* (Brunner), *Lonchodes amaurops* Westwood, *L. brevipes* Gray, *L. everetti* (Brunner), *L. haematopus* Westwood, *L. harmani* Bragg & Chan, *L. jejunos* (Brunner), *L. modestus* (Brunner), *L. strumosus* (Brunner), *Phenacephorus auriculatus* (Brunner), *P. cornucervi* Brunner, *P. sepilokensis* Bragg, *P. spinulosus* (Hausleithner), *Prisomera nigra* (Brunner).

Necrosiinae

The majority of this subfamily are winged and capable of flight. There are about 170 species recorded from Borneo, about 20 of these are wingless or have reduced wings. Of the non-flying species, I have collected 8 and successfully reared 4. Of the fully winged species I have collected 75 and only managed to get one species, *Calvisia conicipennis*, to feed in captivity; although adults were kept alive for several months and eggs hatched, the nymphs refused to feed. *Orxines macklottii* has not previously been recorded from Borneo, however C.L. Chan has two specimens from Sabah; this species has been reared in the UK with stock originating in Java.

Only six species have been successfully maintained in captivity: *Acacus sarawacus* (Westwood), *Asceles margaritatus* Redtenbacher (wingless variety), *Calvisia conicipennis* (Bates), *Diesbachia hellotis* (Westwood), *Centema hadrillus* (Westwood), *Orxines macklottii* (de Haan).

In addition to those listed above *Sipyloidea sipylus* (Westwood) is in culture from Madagascar; the Bornean *Sipyloidea warasaca* (Westwood) has been synonymised with this species but there are a number of differences between Madagascan cultured material and Bornean material so I have excluded this species from the list.

Analysis of culture potential

Of the species which I have collected, approximately 1% of flying species have been maintained in captivity compared to 87.5% of flightless species. Although flightless species are generally found in larger numbers, this does not account for the difference, in several cases wingless species have been maintained and cultures established from a single specimen while common flying species cannot be maintained. The data shows a clear link between the flight capability of the females and the culture potential.

The possibility of maintaining a species in captivity is dependant on finding a suitable foodplant. Obviously a flying insect can be more selective about foodplants as it is able to move around more freely in search of an appropriate plant. However this only applies to the adult insects, some other factor must also exert an effect on the nymphs.

Of the subfamilies under consideration, only two seem to select sites for depositing the eggs, the others scatter their eggs more or less randomly. Those that scatter their eggs are able to move easily in search of food. Newly hatched Phylliinae nymphs climb rapidly and can probably glide from tree to tree so finding a suitable plant may not be difficult. Nymphs of Lonchodinae and Phasmatinae have long legs and can climb quickly in search of a foodplant, as both groups appear

to be quite polyphagous, finding a suitable plant should be quite easy. The ability to drop to the ground and climb rapidly means that they can soon reach the leaves of another plant if their first choice is unsuitable.

The Heteropteryginae bury their eggs in the ground; this group are generally slow moving, however, as they are usually highly polyphagous, finding a suitable foodplant near the ground presents no difficulty. Several species readily feed on leaf litter (i.e. leaves which have been dead, and on the bottom of the cage for several months) in captivity.

The majority of the Necrosiinae lay eggs in specific places, using various mechanisms to ensure that the eggs remain in place. At least two genera, *Asceles* and *Paraloxopsis* pin their eggs to the leaves of plants. *Calvisia* and at least some *Sipyloidea* glue the eggs to leaves and stems, eggs removed from the bodies of other species suggest that this method is probably used in other genera such as *Marmessiodea* and some *Sosibia*. Many species produce cylindrical eggs with a pointed polar end and appear to push the eggs in to gaps e.g. cracks in bark, these include members of *Acacus*, *Aruanoidea*, *Centema*, *Diesbachia*, *Echinoclona*, *Galactea*, *Necroschia*, *Nescicroa*, *Orthonecroschia*, and *Orxines*. These methods ensure that the nymphs hatch out in a place selected by the adult female, so these insects can be monophagous or at least highly selective feeders without the nymphs having to climb up several unsuitable tall trees in the rainforest.

The Aschiphasmatinae are generally capable of good flight but appear to drop their eggs to the ground, this appears to contradict the situation in the Necrosiinae. However all the species observed feeding in the wild have been found on shrubs, or in one case a smallish tree with low branches, the newly hatched nymphs would not have far to climb in order to reach suitable foliage, and if the eggs are only dropped from a low bush they would not travel far from the foodplant. In addition the nymphs of this group seem to move more rapidly than many phasmids, this ability would help the nymphs to reach suitable food.

Non-Bornean winged phasmids

Although there are currently five winged species of Necrosiinae in culture from outside Borneo, this is a minute proportion when one considers the subfamily contains about 800 species, most of which can fly. Most of the cultured Necrosiinae do not fly, only one of the flying species, *Sipyloidea sipylus*, attaches its eggs to plants.

Winged members of the Phasmatidae often have heavy bodies and the females would have difficulty flying, furthermore the eggs are dropped to the ground, polyphagy would therefore be expected. Several species of this group, most from Australia, are being reared in captivity.

Winged Pseudophasmatinae are generally good fliers. Only two species are being reared in captivity, both feed only on privet in captivity although they drop their eggs to the ground.

Summary

The available evidence suggests that there is very little chance of culturing a phasmid in the UK if the females fly well. The ability to fly well is associated with selective egg deposition above ground level, and with monophagy or very restricted polyphagy. Females which are unable to fly are associated with the random scattering, or burying, of eggs; they tend to be polyphagous and relatively easy to culture.